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M.D., Fellow of the Royal College of Physicians. Communicated by John Ayrton Paris, M.D., President of the College.

The object of this paper, which is purely analytical, is to explain a method of resolving numerical equations with real coefficients, which recommends itself by its simplicity and generality.

4. "On the Reproduction of lost parts in Myriapoda and Insecta." By George Newport, Esq., F.R.C.S., President of the Entomological Society of London, and Corresponding Member of the Philomathic Society of Paris. Communicated by P. M. Roget, M.D., Sec. R.S.

It has long been known that the limbs of Crustacea and Arachnida, accidentally lost or designedly removed, are, in course of time, replaced by the growth of new limbs; and the same power of reproduction has been stated to have been observed in the Phasmæ, insects which undergo neither metamorphosis nor any change of habits. But whether such a power exists in those insects, such as the Lepidoptera, which undergo a complete metamorphosis, changing not only their form, but also their food and mode of life, in passing from the larva to the adult state, has been considered as very doubtful. The instances in which the reproduction of lost parts appeared to have occurred in some of the Myriapoda, were attributed to imperfect or arrested development. With a view to determine these unsettled points, the author commenced, in the summer of 1841 and 1842, a series of direct experiments on this subject in the Myriapoda; and in the present summer he has extended them to the Lepidoptera. The results of his labours are given in the present memoir.

In some specimens of *Iulus*, from which he had removed the antennæ and some of the legs, the lost organs were found to be completely reproduced after the next change of integument; differing from the original organs only in their smaller size, and the incomplete development of some of their minuter parts. The same results followed from similar experiments made on the *Lithobris* during the earlier periods of its growth. One individual of this genus, which had already acquired the tenth pair of legs, was by accident deprived of the eighth, ninth and tenth pair; at the next change of skin it not only developed two additional pair of legs, but also reproduced the three pair which had been lost. Some time after this it again lost one of the legs of the twelfth pair; a loss which was repaired at the next change by the growth of a new leg, while those previously reproduced acquired an increase of size.

The first observation which led the author to believe that true insects might possess the power of reproducing lost parts, was that of a specimen of *Phasma* in the collection at the British Museum, in which the right anterior leg had evidently been reproduced. He then instituted a series of experiments on the larva of the *Vanessa urticae*, or common nettle butterfly, which belongs to the order Lepidoptera, and undergoes complete metamorphosis. He removed some of the true legs of the larva, sometimes in their tibial portion,

and sometimes at their base : in the first case, parts similar to those removed were invariably reproduced in different states of development, and in the latter, entire new limbs were formed ; in some instances, at the second change of the larva, when it passed into the pupa state ; but in two or three instances no reproduction took place. At first view, this difference in the results might appear to favour the opinion that this reproduction of limbs depends on the existence of parts especially adapted to perform this function, and which, in those experiments that had failed to exhibit the phenomenon, had been themselves removed. But the author found that in every instance of the mutilations thus practised, the perfect insect possessed a coxa, or basilar part of the limb ; and this was the case even in those in which a new organ was not reproduced. From this fact, taken in conjunction with the formation of new entire limbs in the *Iulidæ* after the removal of every portion of the previous ones, the author infers that the power of reproduction resides in the whole of the organized tissues.

The author found that each newly produced limb is, in every case, composed of all its essential parts, namely coxa, femur, tibia, tarsus and claw ; but its development is scarcely ever entirely normal, being either deficient in some of the tarsal joints, or irregular in the development of its armature.

The following are the general conclusions which the author deduces from his investigations. Slight wounds in the larvæ of insects always heal, except when the viscera have protruded, or excessive hemorrhage has occurred : severe wounds, such as those attending the excision of a limb, also frequently heal. It is when the wound is in the line of action of the principal muscles of the body that protrusion of the viscera takes place. For the healing of wounds, the first requisite is the arrest of the hemorrhage ; and this is effected, as in the higher animals, by the coagulation of the blood, and the formation of a clot ; and then a complete union of the separated parts takes place beneath the eschar formed by the clot. After this union, the reparation of the injury is commenced by a development, from the injured surface, of parts corresponding to those that had been removed. For the production of a new limb, one change of skin, at least, is necessary. The healing of the wound after the removal of a part, and the subsequent reproduction, although they do not prevent, yet certainly retard the natural changes. Lastly, the author has established the fact, that reproduction of lost parts takes place in metabolic as well as in the ametabolic articulata.

The paper is accompanied with drawings of reproduced parts.

5. "On the Changes of Temperature produced by the Rarefaction and Condensation of Air." By James Prescott Joule, Esq. Communicated by P. M. Roget, M.D., Sec. R.S.

In order to estimate with greater accuracy than has hitherto been done the quantities of heat evolved or absorbed during the condensation or rarefaction of atmospheric air, the author contrived an apparatus where both the condensing pump and the receiver were